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GB 1523773 GB 0890309 GB 0304711
GB 1454669 GB 0677129
GB 1415397 GB 0654250

(58) Field of search
G2J

(54) **Iris device having linearly movable blades**

(57) An iris device, for anaglyph stereoscopic apparatus, has first and second members (32, 34, 132, 134) which together define a variable aperture. The blade members (32, 34, 132, 134) are mounted for substantially linear relative movement between a position where the aperture has a maximum size, and a position where the aperture has a minimum size in the direction of blade movement.

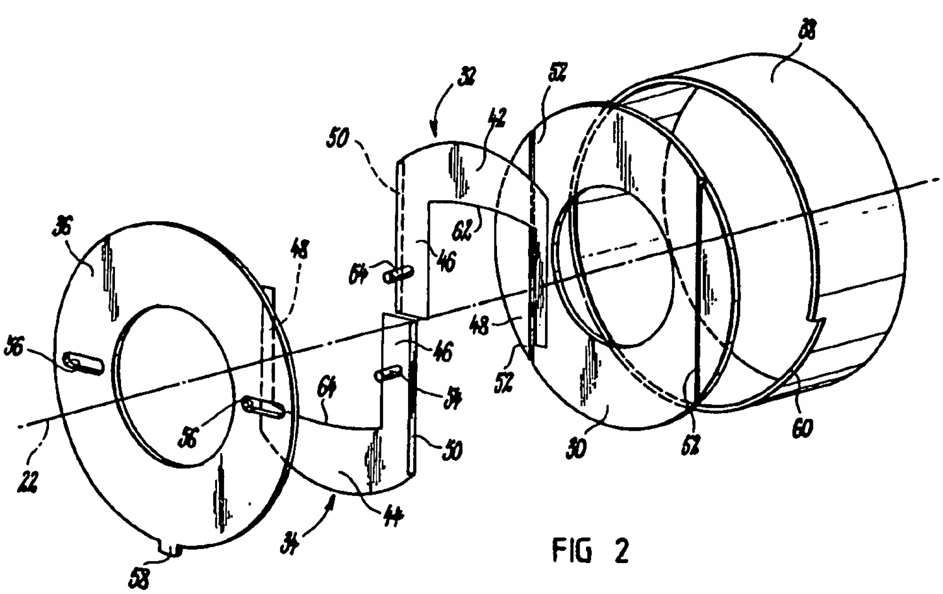

FIG 2

GB 2 164 470 A

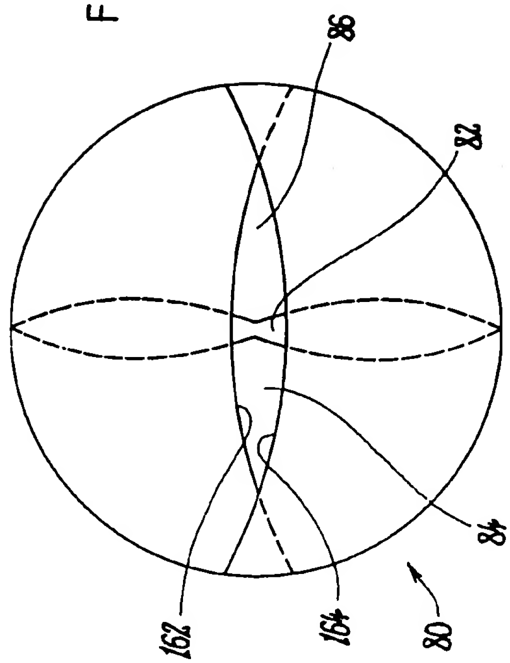

FIG 6B

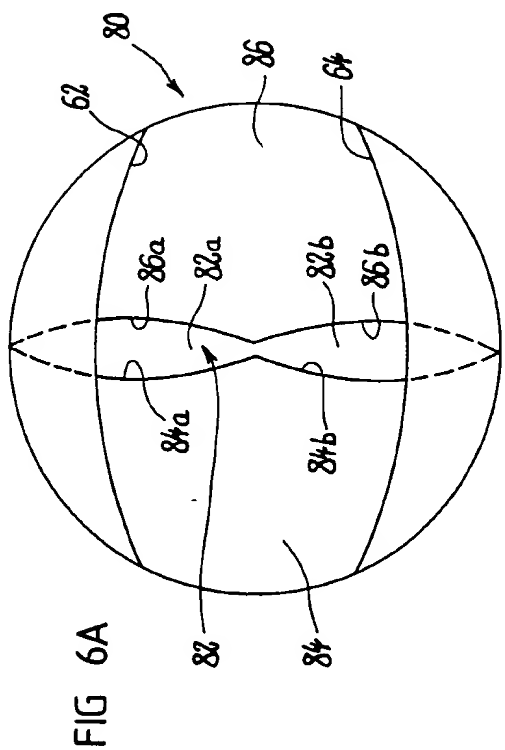

FIG 6A

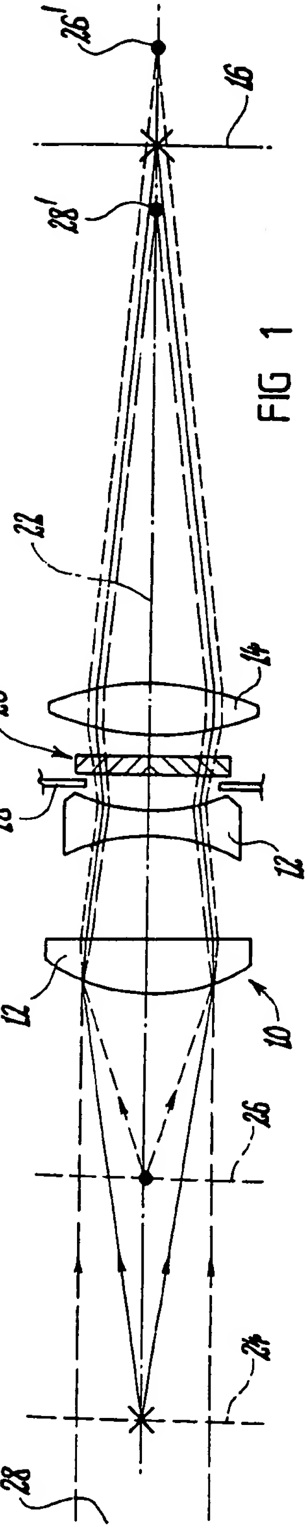

FIG 1

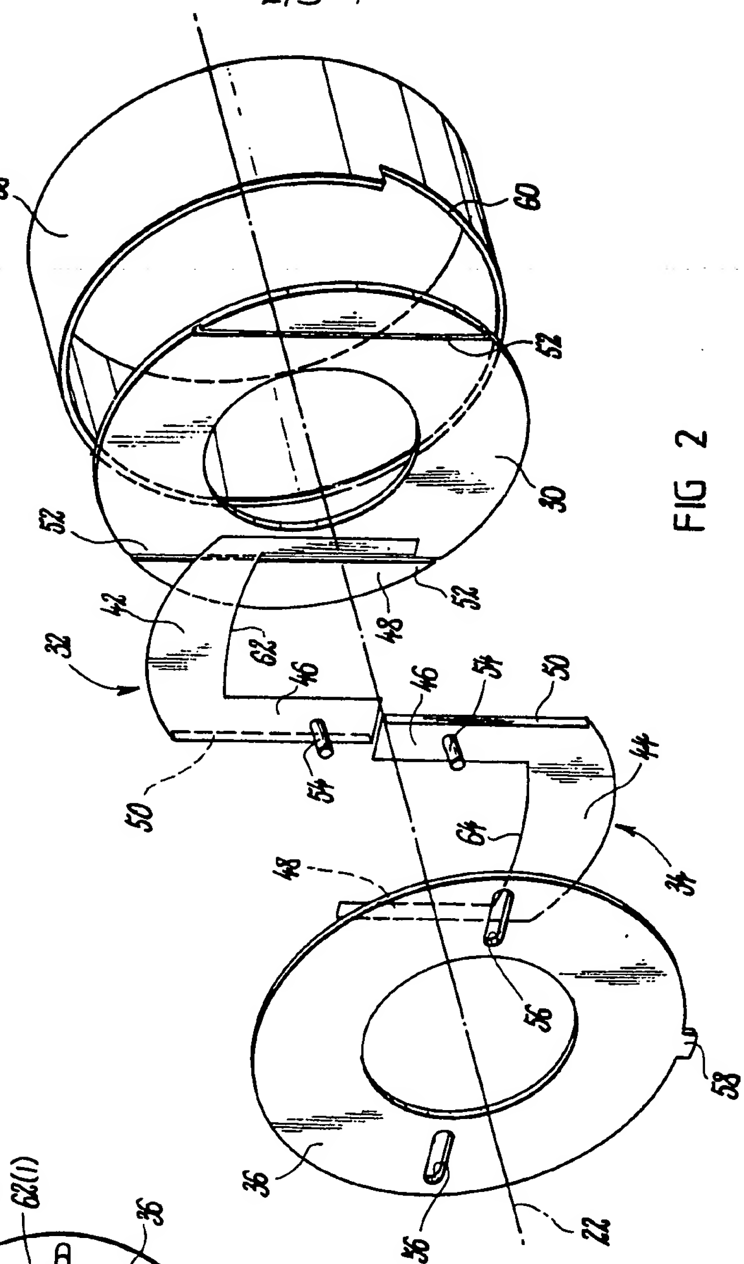
38
60
52
30
52
52
42
48
32
62
46
46
54
50
50
54
44
64
48
34
56
58
36
56
22

FIG 2

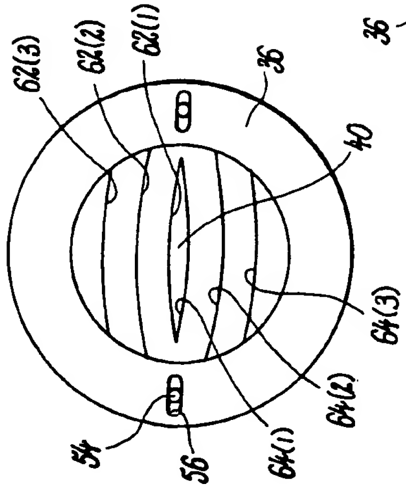
62(3)
62(2)
62(1)
36
40
64(3)
64(2)
64(1)
54
56

FIG 3

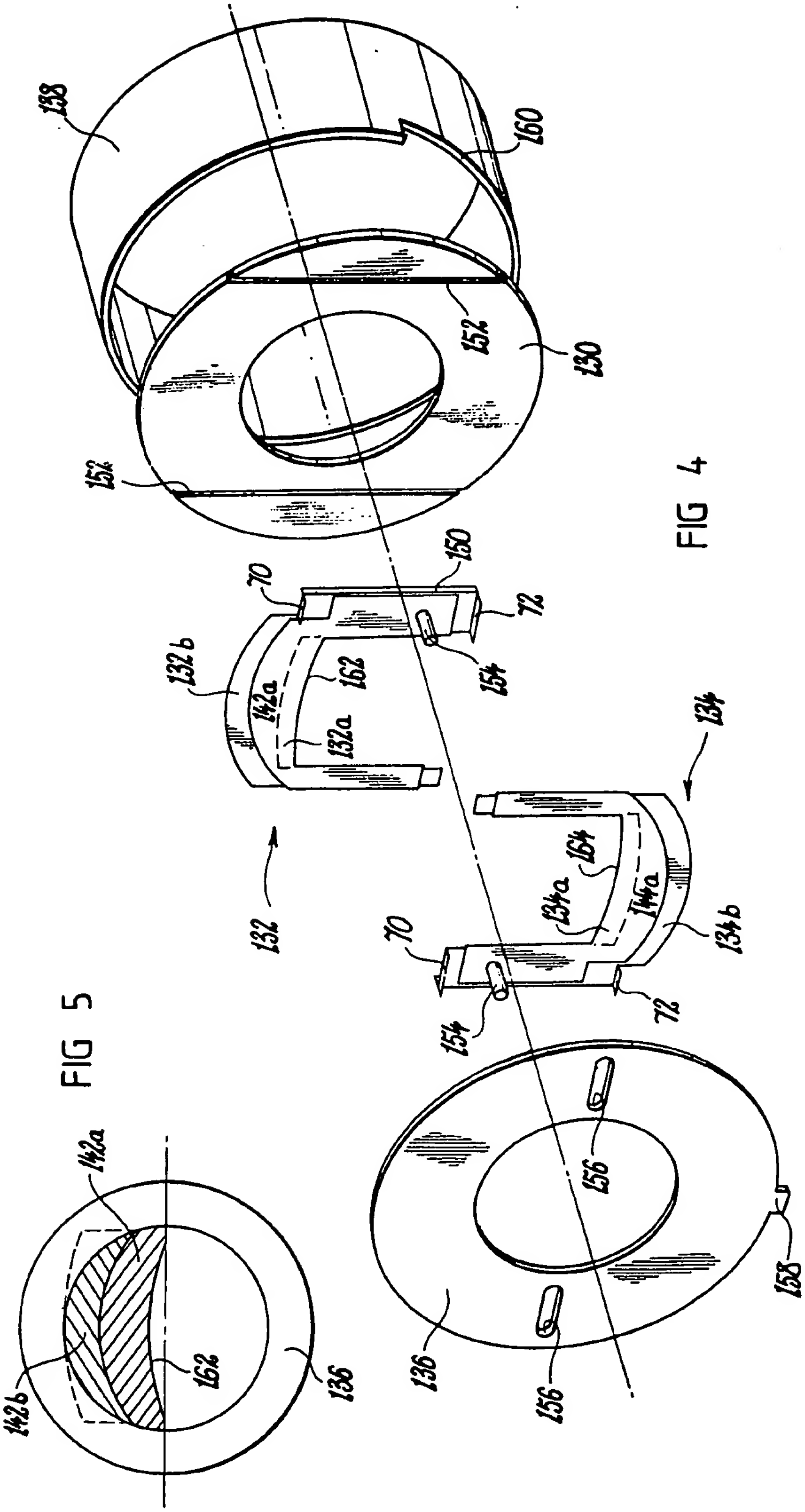
138
160
152
130
152
150
70
72
154
162
132b
142a
132a
132
134
164
134a
144a
134b
70
154
72
156
156
136
158
142a
162
142b
136

FIG 4

FIG 5

SPECIFICATION

Iris device

This invention relates to an improved iris device or use in anaglyph steroscopic apparatus, and to such apparatus incorporating the iris device.

In United Kingdom Patent No. 1604295, the disclosure of which is herein incorporated by reference, there is disclosed improved apparatus for producing a three-dimensional effect from a two-dimensional image carrier having a focussed area containing principal subject matter and a defocussed area containing incidental subject matter. The apparatus includes a lens system and, within the lens system, an optical device comprising a module including a pair of coloured filter elements which are of different wavelength passbands and are laterally disposed on opposite sides of the axis of the module. The module causes an aberration of at least some of the incidental subject in the defocussed area, while not affecting the principal matter of the focussed area. The arrangement is such that, when an image at the plane of focus for the lens system is viewed through a viewer comprising a pair of filter elements, one for each eye and having wavelength passbands balanced with respect to the wavelength passbands of the module filter elements, a three-dimensional effect is achieved, while the image has an acceptable two-dimensional appearance when viewed without the viewer. The effect is achieved by a respective wavelength passband of the module filter elements being blocked by each filter element of the viewer to generate the three-dimensional effect, while the full colour spectrum able to pass between the module filter elements substantially ensures a sufficient degree of clarity is maintained to provide an acceptable two-dimensional effect when the image is viewed normally.

Most practical forms for the module have filter elements having inner edges which define a waisted natural light passage between those elements. That is, the passage for natural light is a minimum dimension between the module filter elements on the axis of the lens system and increases away from that axis. In a highly preferred arrangement for the module, the inner edge of each filter element of the module is of arcuate form.

The apparatus of Patent No. 1604295 normally is used with the module mounted on or in the lens system and, to avoid vignetting, it is desirable that the filter elements of the module be positioned as near as practicable to the iris or aperture plane of the lens system. Excellent results are obtainable although, in general it is found that with the conventional round iris, the quality of the three-dimensional effect is compromised at small aperture settings.

This limitation encountered at small round iris aperture settings is attributable to the fact that the quality of the three-dimensional effect is dependent on the lateral extent of the module filter elements transversed by the image carrier, vis-a-vis the lateral extent of the natural light passage, to achieve defocusing of incidental subject matter. As the aperture setting decreases, it approaches a diameter corresponding to the lateral extent of the natural light passage at which diameter all of the image carrier passes through the natural light passage. However, even before that diameter is reached the quality of the three-dimensional effect deteriorates over relatively small diameter settings for a round iris.

The present invention is directed to providing an improved iris device which alleviates the foregoing deficiency of the convention round iris.

In one aspect, the present invention provides an iris device having first and second blade members which together control the size of the variable aperture, the blade members being mounted so as to be substantially linearly movable relative to each other between a remote or outermost position for which the aperture size in the direction of movement of the blade members is a maximum and an innermost position for which the aperture size is a minimum dimension in that direction.

The invention also provides optical apparatus for use in producing a three dimensional effect from a two dimensional image carrier having a focussed area containing principal subject-matter and a defocussed area containing incidental subject-matter; said apparatus comprising a lens system, a filter module positioned in said system, and an iris device in said lens system, said iris device being in accordance with the preceding paragraph; said filter module including a pair of filter elements each having a different wavelength passbands and being laterally spaced in a first direction so as to be located on opposite sides of an axis of said lens system, said module further including a substantially full colour spectrum passage between said filter elements; said iris device being mounted so that the first and second blade members together control the size of a variable aperture for the lens system, the blade members being substantially linearly movable relative to each other in a second direction which is transverse with respect to the first direction and said axis and such that at substantially all aperture sizes the aperture dimension in the first direction is greater than the dimension of the light passage in that direction; the arrangement being such that said filter module, at substantially all aperture sizes, causes an aberration to be formed on at least some of the incidental subject-matter in the defocussed area which when viewed through a suitable viewer provides a three dimensional

effect but which forms a satisfactory two dimensional image when viewed freely.

In normal use, the iris device is oriented such that one of the blade members is uppermost and the other lowermost; with the direction of their movement being substantially vertical. While such orientation is not essential, it will be assumed in the following for convenience of description. In such case, the periphery of the aperture is defined at least in part by a lower, horizontally disposed edge of the upper blade member and an upper horizontally disposed edge of the lower blade member, each such edge hereinafter being referred to as an aperture defining edge.

As will be appreciated, the aperture defining edges extend laterally with respect to the direction of movement of the blade members. Those edges thus move toward or away from each other with movement of the blade members to decrease or increase, respectively, the size of the aperture. Additionally, when used with a filter module such as disclosed in application 37174/78, those edges extend across each of the filter elements and the light passage between the latter. Thus, during movement of the blade members toward each, and even when the respective aperture defining edges are closely adjacent to define a small aperture, a substantial lateral extent of the filter elements, vis-a-vis the light passage, is transversed by an image carrier passing through the aperture.

Most conveniently the aperture defining edges are slightly concave, with each preferably having a radius of curvature that is relatively large in relation to the maximum dimensions of the aperture. While such concavity implies the aperture defining edges are smoothly or uniformly curved and while it is preferable that the aperture at its minimum size is of substantially lenticular shape, this is not imperative. Thus, in an alternative form, each aperture defining edge may have two mutually inclined linear portions such that the aperture at its minimum size is of horizontally elongate rhombic or diamond shape.

In respective forms of the invention, each blade member may consist of a single blade element or at least two overlapping and relatively movable blade elements. In each case, the elements are relatively thin and may be formed for example of a suitable opaque plastics material or metal. Where the blade members are of a multi-element form and of plastic, a low friction plastic such as PTFE most conveniently is used.

As will be appreciated, the single element form of blade member requires that housing for the iris device can accommodate movement of the blade members, in the direction of their movement, over at least twice the dimension of the maximum aperture in that direction. Use of blade members comprising at least two blade elements allows that requirement to be significantly reduced.

In the multi-element blade member, the elements of each member overlap and are relatively movable in the direction of relative movement of the blade members. Movement of the blade members from their outermost to their innermost positions thus entails movement of the elements to decrease the extent to which they overlap, and vice versa.

In each form of the invention, the blade members most conveniently are mounted for movement in an arrangement in which they are guided in, and preferably also constrained to, their linear movement. In the case of the single element blade members, this may be achieved by providing a carrier member defining at least one guide slot; with each element having a guide member located in the or a respective guide slot. Alternatively, a guide slot may be provided on each element; with a respective guide member on the carrier member being located in each slot.

A similar arrangement can be used where the blade members are of multi-element form. However, while each element may for example have a respective guide member located in a guide slot of the carrier member, it normally is sufficient to have only one element of each blade member in such guided relation.

Also in the multi-element form of blade member, it normally is convenient to have a lost-motion coupling between the elements. Thus, in the case of a two element blade member, movement of the blade member from its innermost or its outermost position may be initiated by movement of one of the elements and thereafter by both elements together. Normally, it will be convenient to have the same element provide the initial movement in each case, and that element preferably is the one defining the aperture defining edge near the other blade member and extending transversely of the direction of movement of the blade members.

A variety of lost motion couplings between the elements of a blade member can be used. In the case of a two element member, the one of the elements to provide initial movement may be located between a pair of stops provided on the other element. In such case, the stops will be spaced in the direction of movement of the blade member; the arrangement, for example, being such that during initial movement of the blade member from either of its positions its one element moves from a respective one of the stops to engage the other of the stops and thereafter the one element draws the other element with it.

In a blade member of three elements, three elements normally being sufficient, a more practical arrangement is to have a projection, such as a pin, mounted on the one element to provide initial movement and located in aligned slots of the other elements. The slots are of progressively greater length in successive

ones of the other elements such that after initial movement of the one element, a second element is drawn with it relative to the third element, after which all three elements move together. Most conveniently, the sequence of movement is the same, regardless of the direction of movement of the blade member.

A variety of mechanisms can be used to effect movement of blade members. However, even though their movement is to be substantially linear, it is most practical that the movement is by means of a rotatable member, of similar nature to the aperture ring of the conventional round iris. This not only provides for compatibility with conventional cameras and the like, but also is more practical for installation in a suitable housing.

For single element blade members, movement of the latter may be controlled by an annular aperture ring having an inner diameter at least as great as the required aperture and coupled to each blade member such that axial rotation of the ring in one or other direction moves both blade members toward their innermost or outermost position, repectively. A suitable coupling can be provided by a pin mounted on each blade member and projecting parallel to the axis of the ring being located in a respective radially extending slot in the ring. However, it will be appreciated that the converse arrangement, i.e. with pins on the ring each located in a such axially extending slot of a respective blade member also, can be used.

Similar arrangements can be used for multi-element blade members. However, in this case, it is necessary only to have the coupling between the ring and the first one of elements of each blade member that is to move. Also, it is to be appreciated that other arrangements for effecting the movement of the blade members can be used in the case of both the single and multi-element members.

In order that the invention may more readily be understood, reference now is directed to the accompanying drawings, in which:

Figure 1 is a schematic view of a typical lens system incorporating one form of iris device;

Figure 2 is an exploded perspective view of an iris device;

Figure 3 is a view from the left hand side of Figure 2, showing different aperture settings;

Figure 4 is a view similar to that of Figure 2, of a further iris device;

Figure 5 is a view from the left hand side of Figure 4, corresponding to Figure 3; and

Figures 6A and 6B show a modified form of filter module for use with the iris device.

The lens system 10 of Figure 1 is that of a camera adapted for taking photographs which are of normal two-dimensional form. However, it is to be understood that the system is equally applicable to other formats, such as television.

System 10 has taking lenses, including forward lens 12 and rearward lens 14, which enables objects in object space to be focussed on film 16. Within system 10 there is an iris 18 and a filter module 20. The latter for the present purposes is to be understood as corresponding in form to that described in application 37174/78.

As will be appreciated from application 37174/78, module 20 includes a pair of differently coloured filter elements laterally spaced with respect to axis 22 of system 10 so as to define a light passage therebetween on axis 22. Desirably, the two colours used in the filter element select wavelengths at opposite ends of the visible spectrum; the respective colours for example being red and cyan.

In use, light from the object space defining the scene being photographed, i.e. the image carrier, passes through lens system 10 onto the film 16. Each filter element of module 20 at least partially blocks respective colours from passing through that portion of the module it occupies. Thus, a red filter will transmit reddish colours but progressively block other colours toward the blue end of the spectrum with substantially all blue colours being blocked, while a cyan filter acts in a complementary way by progressively blocking colours toward the red end of the spectrum.

The consequence of the foregoing is that the principal subject image denoted by plane 24, with the lens system focussed on that plane, is sharply focussed at the plane of film 16. The filter elements of module 20 have no relevant effect on the principal subject image since light passing through each of them, as well as light passing through the light passage between the filter elements, is brought into co-incidence in the plane of film 16 to provide a substantially true colour balance for objects in plane 24. However, such co-incidence does not occur for incidental objects in front of plane 24, such as those in plane 26, or for objects behind plane 24, such as denoted by substantially parallel rays 28. Incidental objects in plane 26 are focussed behind the film at 26', while incidental object denoted by rays 28 are focussed in front of the film 28' and, due to the respective rays convering behind and in front of the film, the corresponding images will be characterised by respective lateral offsetting of blue and red components.

When viewed unaided by the naked eye, a photograph reproduced (or a television transmission received) using such system of Figure 1 appears two dimensional. The lateral off-setting does not materially detract from the image, as compared with an image formed by such system without the module. That is, although colour fringes resulting from the off-setting is detectable in incidental foreground and background images, the fringes are not normally noticeable in the context of the defocussed portion of the total image.

With reference to Figure 2, an iris device 18 for such system is illustrated. Device 18 has an annular carrier member 30 on which upper and lower blade members 32, 34 are vertically slidable, and an annular aperture ring 36 by which sliding members 32, 34 is controlled.

The members 30 and 36 are co-axially retained in an annular sleeve 38 such as the barrel of a camera lens system, with members 32,34 located therebetween. The inner diameter of each of members 30 and 36 is at least equal to the maximum size of the aperture 40 of the iris device.

Each of blade members 32,34 has a blade 42,44 which extends horizontally above or below, respectively, axis 22. Also, each blade member has vertical end arm portions 46,48 which project toward the blade of the other blade member. Arm portion 46 of each blade member longitudinally overlies arm portion 48 of the other blade member; while each arm portion 46 has a flange 50 along its vertical edge which is located in a respective vertical guide slot 52 in carrier member 30 to guide blade members, 32,34 in vertical movement.

Also, each arm portion 46 has a horizontally extending pin 54 projecting away from member 30 and located in a respective radial slot 56 formed in ring 36.

The device, when assembled, is such that ring 36 is rotatable in sleeve 38. For this purpose, radial tab 58 projects through a circumferential cutout or slot 60 in sleeve 38 for manual adjustment. Rotation of ring 36 anticlockwise as viewed in Figure 2, causes pin 54 of blade member 32 to be drawn downwardly, and pin 54 of blade member 34 to be drawn upwardly, with resultant sliding of the blade members toward each other. As will be appreciated, the elongate radial extent of slots 56 allows pins 54 to move in a vertical parth due to the constraining action of guides 50 in slots 52. Clockwise rotation results conversely in the blade members moving apart.

Each blade 42,44 has an aperture defining edges 62, 64 comprising the lower and upper horizontally disposed edge, respectively, of each member. As shown, each edge 62,64 is concave and conveniently forms part of a circle having a relatively large radius compared with maximum dimensions of variable aperture 40 defined therebetween. Thus, when blade members 32,34 are remote from each other, part of the circumference of aperture 40 is bounded by arm portions 46,48, the inner periphery of carrier 30 and/or the inner periphery of ring 36.

As blade members 32,34 move toward each other, a point is reached when the adjacent outer extremities of edges 62,64 meet and then progressively overlap, such that the aperture 40 is entirely defined by edges 62,64 and is of horizontally disposed lenticular form. That is, the horizontal dimension of aperture 40 becomes relatively large in relation to the vertical dimension, a relationship which is maintained down to the smallest aperture size. As a consequence of this light passing from object space through aperture 40, even at the smallest aperture size, continues to have a sufficient portion thereof, compared with the portion passing through the light passage of module 20, partially blocked by each filter element of module 20 for incidental objects of object space defocussed in the plane of film 16 by lateral offsetting of respective color images. The balance thus remains substantially as for large aperture sizes in that lateral offsetting of blue and red components occurs for such incidental objects, to provide an image at film 16 which provides a three-dimensional representation when viewed through appropriate view elements but a normal two-dimension form when viewed unaided.

Figure 4 shows an alternative form of iris device in which parts corresponding to Figure 2 are identified by the same reference numeral, pluss 100. Device 118 differs from device 18 principally in that blade members 132 and 134 have two overlapping and mutually vertically slidable blade elements 132*a*,*b* and 134*a*,*b*; each similar in overall form to members 32,34. Each element 132*a*, 134*a* has a pin 154 located in respective slot 156 in ring 136, with the respective blades 142*a*, 144*a* thereof having aperture defining edges 162,164. Each element 132*b*, 134*b* has a flange 150 located in a respective vertical guide slot 152 in carrier member 130. Additionally, each element 132*b*, 134*b* carries two vertically spaced stops 70,72.

The arrangement is such that with rotation of ring 136 clockwise as viewed in Figure 4, elements 132*a* and 134*a* are drawn down and up, respectively, by pins 154 to initially slide elements 132*a* relative to element 132*b* and element 134*a* relative to element 134*b*. Such relative sliding continues until elements 132*a* and 134*a* contact stops 70 after which they draw elements 132*b* and 134*b*, respectively with them on continued clockwise rotation of ring 136. With anti-clockwise rotation of ring 136, reverse relative sliding occurs until elements 132*a* and 134*a* contact stop 72, after which they draw element 132*b* and 134*b*, respectively, with them. The full required clockwise rotation of ring 136 thus reduces the extent of overlap of the elements of members 132,134; while the full anti-clockwise rotation increases the extent of that overlap.

As will be appreciated, the overall functioning of device 118 is similar to that of device 18. However, the double element form of members 132,134 of device 118 significantly reduces the radial dimension of sleeve 138 necessary to accommodate members 132,134 at larger sizes for aperture 140.

Figure 3 shows successive aperture settings for device 18. For simplicity, blade members

32,34 are identified only with reference to aperture defining edges 62,64. The successively larger aperture sizes denoted by the increasing number in parenthesis.

Figure 5 shows a similar view of device 118. However, for simplicity only a single aperture size is illustrated, while blade 134 is omitted.

The devices 18,118 provide improved performance over the conventional round, concentrically variable lens when each is used with a filter element module as disclosed in application 37174/78. However, devices 18,118 provide further improved performance when used with a modified module as illustrated in Figure 6A and 6B.

The module of 37174/78 is characterized by a natural light passage which is "waisted" as a result of being defined in part by a convex inner edge for each filter element. The module 80 of Figures 6A and 6B also has a waisted natural light passage 82. However, as shown, this is produced by the inner edge of filter elements 84 and 86 having, above and below the horizontal centre line of the module, convex inner edge portions 84*a*,*b* and 86*a*,*b*. Passage 82 thus is characterized by vertically disposed substantially lenticular portions 82*a*,82*b* which merge at the centre line.

As shown in Figures 6A and 6B, the configuration of the aperture defining edges 62,64 (or 162,164) of the device 18 (or 118), and the configuration of the edges of filter elements 84,86 result in a portion of light passage being operative even at small aperture sizes. Also, even at such aperture sizes, a significant area of each of elements 84,86, relative to the operative portion of passage 82, remains operative such that a three-dimensional effect is obtainable, for an image viewed through appropriate viewer, while the image has a good two-dimensional appearance when viewed with a viewer.

Finally, it is to be understood that various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the spirit and ambit of the invention.

CLAIMS

1. An iris device for use in anaglyph stereoscopic apparatus, said iris device having first and second blade members which together define a variable aperture, the blade members being mounted so as to be substantially linearly movable relative to each other between a remote or outermost position for which the aperture has a maximum size in the direction of movement of the blade members and an innermost position for which the aperture has a minimum size in that direction.

2. An iris device as defined in claim 1, wherein each blade member has an aperture defining edge which extends laterally with respect to the direction of movement of the blade members.

3. An iris device as defined by claim 2, wherein said edges are concave and have a radius of curvature which is relatively large in relation to dimensions of the aperture at said maximum size.

4. An iris device as defined in claim 2, wherein each said edge has two mutually inclined substantially linear portions such that, with the aperture at its minimum size, the aperture has a diamond or rhombic shape.

5. An iris device as defined in any one of claims 1 to 4, further including a carrier member defining at least one guide slot, each blade member having a portion thereof located in the or a respective said slot and guided thereby in relative movement in said direction.

6. An iris device as defined in any one of claims 1 to 4, wherein at least one of said blade members defines a guide slot, the deivce including a carrier member having a guide means located in the or each said slot whereby said blade members are guided in relative movement in said direction.

7. A device as defined in any one of claims 1 to 6, further including adjustment means for adjusting the aperture size, the adjustment means being coupled to each blade member such that the blade members are caused to move in said direction on rotation of the adjustment means.

8. A device as defined in claim 7, wherein the adjustment means is of annular form and is so coupled by each blade member having a projecting pin located in a respective slot in the adjustment means.

9. A device as defined in claim 7, wherein the adjustment means is of annular form and is so coupled by each blade member having a slot in which is located a respective pin projecting from the adjusting means.

10. A device as defined in any one of claims 1 to 9, wherein each blade member comprises at least two overlapping blade elements which are relatively movable in said direction.

11. A device as defined in claim 10, wherein a lost-motion coupling is provided between the elements of the blade such that movement of the blade from one to the other of said innermost and outermost position initially is by movement by one element and thereafter by at least two elements together.

12. Optical apparatus for use in producing a three dimensional effect from a two dimensional image carrier having a focussed area containing principal subject-matter and a defocussed area containing incidental subject-matter; said apparatus comprising a lens system, a filter module positioned in said system, and an iris device in said lens system, said iris device being a device as defined in any one of claims 1 to 11; said filter module including a pair of filter elements each having a different

wavelength passbands and being laterally spaced in a first direction so as to be located on opposite sides of an axis of said lens system, said module further including a substantially full colour spectrum passage between said filter elements; said iris device being mounted so that the first and second blade members together control the size of a variable aperture for the lens system, the blade members being substantially linearly moveable relative to each other in a second direction which is transverse with respect to the first direction and said axis and such that at substantially all aperture sizes the aperture dimension in the first direction is greater than the dimension of the light passage in that direction; the arrangement being such that said filter module, at substantially all aperture sizes, causes an aberration to be formed on at least some of the incidental subject-matter in the defocussed area which when viewed through a suitable viewer provides a three dimensional effect but which forms a satisfactory two dimensional image when viewed freely.

13. Apparatus as defined in claim 12, wherein each of said filter elements has a convex edge at its boundary with said passage such that the width of said passage in said first direction is a minimum at or adjacent said axis.

14. Apparatus as defined in claim 12, wherein each of said filter elements has an edge at its boundary with said passage which is concave to either side of said axis in the second direction, such that said light passage to each side of the axis in said direction is substantially lenticular.

15. An iris device for use in anaglyph stereoscopic apparatus, substantially as hereinbefore described with reference to Figure 1, Figures 2 and 3, Figures 4 and 5 or Figures 6A and 6B of the accompanying drawings.

16. Optical apparatus for use in producing a three dimensional effect from a two dimensional image carrier, substantially as hereinbefore described with reference to the accompanying drawings.

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